

Chemical Feed Systems -- Real Science

Chemical engineering processes generate safe drinking water, therefore the design of chemical feed systems require special attention. Chemical feed systems must be suited to handle, store, feed, and mix the chemicals used in water treatment plus be able to accommodate the variations in plant flow rate and chemical dosages. The preferred chemical feed system is the liquid volumetric feeder because it is clean, compact, accurate, convenient, easy to operate, not labor intensive and does not present problems associated with chemical dust and fumes.

The design must take into consideration several factors, including raw water quality, desired finished water quality, ability to treat the water, safety regulations (OSHA plus other local, state and federal regulations), clogging of feed lines, mode of chemical feeding and handling and storage of chemicals. The availability and cost of a chemical can become an important consideration in the ability to treat water because some chemicals may not be available in remote areas. Researching the local availability of chemicals used in water treatment becomes an important component in the design stage.

Chemicals used in Water Treatment

There are over 50 chemicals used at one time or another in systematic ways to prepare safe drinking water. Years ago, chemicals were dumped into the treatment system based on "best professional guess." Today, proper use of chemicals requires jar testing to determine proper chemical dose. There are many factors influencing dosage, chemical effectiveness and reaction (e.g. coagulation, flocculation), such as water temperature, pH, raw water source and suspended solids. Achieving effective water treatment and optimization requires jar tests.

The table below lists a few chemicals and their specific process (use) in drinking water treatment. Some of these chemicals have been around for years as mainstay compounds or experienced a resurgence in use. Mainstay chemicals include alum, chlorine, soda ash, lime, powdered activated carbon and copper sulfate. Operators must refer to AWWA quality standards for technical information and recommendations for safe handling, storage, feeding and use of these chemicals.

Process	Chemical Name
Coagulant or Flocculant	Aluminum sulfate (primary coagulating agent) Bauxite (hydrated aluminum oxide in manufacture of alum) Ferric sulfate (ferrous sulfate chlorinated) Ferric chloride (coagulation of sewage) Ferrous sulfate (combined with lime for coagulant) Sodium aluminate (coagulant for low pH, turbid water) Calcium hydroxide Calcium oxide Cationic polymers Anionic polymers
Coagulant aids	Bentonite (form of clay used in low turbidity water) Calcium carbonate (chalk used as coagulant aid) Carbon dioxide (coagulant aid to adjust pH or solubility) Sodium silicate (activated silica to toughen floc)
Disinfection and chlorination	Anhydrous ammonia Ammonium hydroxide or aqua ammonia

	Ammonium sulfate (formation of chloramines) Chlorine Chloramine (chlorine + anhydrous ammonia) Chlorine dioxide (chlorine + sodium chlorite) Sodium chlorite (highly oxidizing) Chlorinated lime (disinfectant 39% available chlorine) Calcium hypochlorite (HTH=70% chlorine + 3-5% lime) Liquid oxygen (LOX) Sodium hypochlorite (liquid bleach)
Dechlorination	Activated carbon (form of charcoal) Ion-exchange resins (requires careful selection) Sodium bisulfite Sodium sulfite Sulfur dioxide
pH adjustment	Calcium carbonate Carbon dioxide Calcium oxide (quicklime for pH adjustment) Calcium hydroxide Hydrochloric acid (increases chlorine content) Lime Sodium carbonate (soda ash) Sodium hydroxide (caustic soda) Sulfuric acid
Fluoridation and fluoride adjustment	Aluminum oxide (activated alumina; fluoride remover) Ammonium silicofluoride Calcium fluoride Fluorspar (source of fluoride) Hydrofluosilicic acid (source of fluoride) Sodium fluoride Sodium silicofluoride (primary compound for fluoridation) Activated alumina or aluminum oxide (removes fluorides)
Taste and odor control	Bentonite Chlorine Chlorine dioxide (chlorine + sodium chlorite) Copper sulfate (used for algae control) Granular activated carbon (GAC) Powdered activated carbon (PAC; form of charcoal) Potassium permanganate Ozone
Mineral oxidation	Chlorine Chlorine dioxide (chlorine + sodium chlorite) Ozone Potassium permanganate
Stabilization and corrosion control	Calcium oxide (quicklime) Calcium hydroxide Sodium carbonate Sodium hexametaphosphate (sequestering agent)

Softening	Carbon dioxide Calcium oxide (quicklime) Calcium hydroxide Lime Sodium carbonate (soda ash) Sodium chloride Sodium hexametaphosphate (water softener) Sodium silicate
Crorrosion control	Sodium hydroxide (caustic soda) Sodium metaphosphate Zinc orthophosphate
Algae and Aquatic Organism Control	Copper Sulfate Potassium Permanganate Chlorine

Major Chemical Suppliers:

1. AC Industry
2. Allied Chemicals
3. American Cyanamid
4. American Novelty Company
5. Arco Chemical
6. Asher-Moore Company
7. Ashland Chemical
8. Calgon Corporation
9. Carus Chemical
10. Conray Chemical
11. Delta Chemical
12. Dow Chemical
13. Drew Chemical
14. DuPont
15. Essex Chemical
16. FMC Corporation
17. Hill Brothers Chemical
18. Hacros Chemical
19. Industrial Chemicals
20. Inferox
21. J.T. Baker Chemical
22. Jones Chemical
23. Kraft Chemical
24. McKeeson Chemical
25. Monsanto
26. Nalco Chemical
27. Occidental
28. Olin Corporation
29. Pennwalt Corporation
30. Rugger Chemical
31. Stauffer Chemicals
32. Technical Products Company
33. Tennessee Chemical
34. Trans-Pacific Carbon Corporation
35. Thompson Chemical
36. Union Carbide
37. Virginia Clum
38. Vulcan Chemical
39. Westco Chemical